

TYPES OF RESPONSIBILITY AND RESPONSIBILITY CONFLICTS IN SCIENCE AND TECHNOLOGY: AN ANALYSIS OF CODES OF ETHICS AND RESPONSIBILITY PROBLEMS IN ENGINEERING.

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Abstract: It is the goal of the ongoing project mentioned in the headlines above to overcome deficiencies in the analysis of concepts of responsibility by means of a differentiated typology of responsibilities on various levels and by referring to specific examples and typical situations in science and technology. Rules of priority will be defined and related to specific cases. The following thesis will serve as a guideline: conflicts between various types of responsibility can be analytically prepared for a possible solution and be brought closer to a solution by means of the differentiated typologies of responsibilities and by rules of preference.

Resumen: El objetivo del presente proyecto, mencionado en el título de este artículo, consiste en superar las deficiencias en el análisis de los conceptos de responsabilidad mediante una tipología diferenciada de responsabilidades en varios niveles y por referencia a ejemplos específicos de situaciones típicas en ciencia y tecnología. Reglas de prioridad serán definidas y relacionadas con casos específicos. La siguiente tesis puede servir como directriz: los conflictos entre varios tipos de responsabilidad pueden ser analíticamente preparados para una posible solución y aproximados a su solución por medio de tipologías diferenciadas y reglas de prioridad.

Institutional proposals and methodical procedures for the solution of responsibility conflicts will be discussed according to their nature and efficiency. Special emphasis will be placed on examining the problems of distributing (co)responsibility. Specific responsibilities of engineers, scientists, and technical and scientific organizations will also be discussed. Divers papers and books on this subject have appeared in print, and some are planned.

An investigative observation of ethical codes of engineers and systematic comparisons and analyses has been conducted; context-related

and formal differences can thus be ascertained. Context-related differences discriminate between ethical-moral obligations and imperatives, internal corporate norms, role responsibilities, and rules of priority, duties, etc. of the profession. Formal differences discriminate between basic principles and canonical rules and guidelines (regulations). The (analysed) codes rather have the function of a fixed ethos than that of a real ethical code; institutionalized possibilities of implementation of these codes, rules of priority, etc. should be developed and taken into consideration and operation more extensively and intensively. As well, the transformation into positive legal norms has to be analysed and tested. The genuine moral parts should be more clearly separated from the mere professional-internal parts to avoid misunderstanding and to raise the effective control of the codes.

1. MAIN POINTS OF THE PROJECT AND PROVISIONAL RESULTS

1.1 Responsibility *as an Interpretational Construct*

The starting point of the following general analysis was the argument that all that we, as perceptive and active beings, can conceive of and present as well as communicate, is fundamentally dependent upon interpretation. A human being is necessarily an interpretative being; that is, he or she unavoidably uses interpretation in thinking, in perception, in action, in structuring, in construction, and *a fortiori* in evaluating. This is implied by the basic principle of interpretation-impregnation or interpretativity regarding the dependence of all perception and action on interpretation. The results of interpretation processes can be called interpretational constructs; they would figure at the beginning as well as at the end of interpretation processes. Theoretical descriptions and above all the evaluative attributions, are thus interpretation-impregnated imputations.

The model of the interpretational constructs applies to actions as well as to such concepts as motives and motivation, even to the concepts of subject, and conscience, to the normative assignment of responsibility (e.g. in social psychology) and to normative attributions of responsibility. The model of the interpretative constructs emphasizes the constitutive aspect of interpretation, that is, the activist-constructive factor and the character of the action as well as the projective-injective factor of interpretation.

"Responsibility" is not just a concept solely to be used descriptively –someone is responsible– but also above all an evaluative attributive concept –somebody is held responsible– that opens the normative, even ethical dimension of action in a stricter sense. The concept of responsibility itself is a diverse concept of structure or relation that is linked to assignment, attribution and imputation, a scheme that needs to be analyzed and interpreted with respect to the following elements:

someone: the subject or bearer of responsibility (a person or a corporation)

is

responsible

for: something (actions, consequences of actions, situations, tasks, etc.)

in view of: an addressee ("object" of responsibility)

under supervision or judgement of: a judging or sanctioning instance

in relation to: a (prescriptive, normative) criterion

within: a specific realm of responsibility and action.

Responsibility is firstly a concept that figures within a relational attributive norm (controlled expectation of action and behavior). Responsibility means that a person must justify actions, consequences of actions, situations, tasks, etc. in front of an addressee and before an instance of justification to whom he or she has obligations or duties of justification, both not being necessarily identical with one another, in accordance with standards, criteria, norms, etc. The responsible person is accountable for his or her own actions, and under specific conditions also for actions performed by others for whom he or she is vicariously responsible. (Parents, for example, are liable for their young children for a certain wrong conducted by these, maybe in the sense of the violation of supervisory duty.) The concept of responsibility structures social reality (of norms), and social behavior and relations. One can differentiate between the typical bearers of responsibility in terms of active roles and observer roles. One imputes or attributes a specific responsibility to oneself as an actor or to others from the perspective of participant, observer or scientist, in relation to rules and norms that apply beyond the individual. The attribution (in a particular case) activates, that is, instantiates, the general pattern of responsibility in a specific instance. Imputation of responsibility lies as much in self-interpretation as in the interpretation of the actions of others.

Responsibility is therefore attributed or imputed: on the one hand one establishes from the perspective of *observation* that somebody (A)

is responsible, causally or according to a criterion, for an action (for acting or refraining from action), for the consequences of an action, or for the occurrence of an event. On the other hand, the actor (**A**) can also be *made* responsible. This attribution can thus be understood either descriptively or normatively; it is descriptive or normative. Both can be differentiated by a careful analysis, even if in effect both attributions are often considered simultaneously.

The previous discussion about the attribution of responsibility shows that the distinction between the descriptive and normative attitude and a descriptive or normative assumption of the attribution or imputation, respectively, has thus far not been sufficiently taken into consideration. A necessary condition of the descriptive attribution (to describe **A** as responsible for **X**) and of the normative attribute (to make **A** responsible for **X**) is that the (intentional) actor (**A**) is the causal agent, or is at least capable of intervening in the causal chain that leads to **X**. An evaluation of (**A**) can be made, with references to (normative) criteria, of the methods in which he or she was, or could be, brought to take the respective responsibility. The origin of the descriptive concept of responsibility also, as closer analysis will show, can be traced back to the normative one, i.e., to social and conventional normatization or to a requirement established by an authority.

As one distinguishes between a general responsibility for the results of an action from a kind of role-responsibility and task-responsibility, and from legal and moral responsibility, a second aspect of interpretation becomes clear: the responsibility for the result of an action is at first just seen as a superordinate, schematic, formal division; it must be related, through the contextual specifications of tasks or roles or through (universal) moral or legal interpretation to the appropriate realm of substantial values and norms. Only then can its content and sense be comprehensible.

Distinct types of responsibility would structure the social, that is, the normative, reality in different ways. They have specific structural implications (structural implications in this context meaning structurally produced, that is, assumed or implied (analytic) consequences of the basic theory or concept). Conceptual instruments of analysis such as institutionalized (normative) rules and criteria of (types of) responsibility also may structure the concrete responsibility attributions and their consequences. Thus, specific and more concrete expectations and demands follow from the relevant applications of the various types of responsibility. Certain tasks and duties, for example, are tied

to a role that relates exclusively to the rolebearer, and are not so person-oriented as, e.g., in the cases of an activated moral responsibility.

1.2 *Moral Problems in the Sciences, Social Sciences and Economics*

Important and relevant themes for a practical ethics of responsibility in the sciences include, among others, the analysis and discussion of examples of conflicts of responsibility in the sciences, the question of scientific neutrality, the question of whether or not judgments can be value-free, the independence of ethics in research, science organizations and technology, the various situations of today's big science enterprises in comparison to the typical one-person research projects of the past, a Hippocratic oath for scientists, rules of priority, the responsibility of institutions and corporations, ethos vs. ethics, and professional ethics. The following hypotheses have been formulated with regard to these themes.

1. Belief in the complete neutrality of scientists, technology or science as an institution is as unrealistic as holding only scientists and technical experts as individuals totally responsible for the consequences of their application of science or technology would be.

2. Analytically, one should differentiate as much as possible between the poles of pure fundamental research and technical application; between discovery, development and implementation. In between these extremes, however, it is imperative to take into account the conditions of applied science or application-oriented fundamental science, according to the context of the problem.

3. Models are necessary to render more understandable the external co-responsibility of scientists and technical experts to society and humanity, as regards the information of the public on application and research risks available and to make group responsibility more tangible. They must be made implementable, if they are not to degenerate into empty phrases. To achieve this, they must be related to individual responsibilities in a differentiated and operationally comprehensible and tangible way, without being over-simplified or just logically reduced to individual responsibility.

4. Rules of priority for dealing with responsibility in conflicting groups should be designed and tested with regard to the role of public discussion in the social sciences, humanities, philosophical analysis, etc.

5. Ethics Committees and Institutional Review Boards (IRBs) should exist not only in hospitals and in medical and pharmaceutical research, but in all research organizations and projects where there is a *direct* connection to people; thus, in all experiments involving humans (but also in experiments with animals –which pose their own problems.)

6. Codes of ethics and professional codes should be developed, especially for scientific committees and technical organizations. (In Germany we are still behind in this respect in comparison with other industrialized nations.)

7. Legal regulations should be developed further, especially where institutional questions, large projects and applications for planning in technical and applied science fields are concerned, and most especially in political implementation. It remains to be seen if the relevant proposed models of science courts, parliamentary hearings, Enquête commissions, etc., are appropriate for such matters.

8. The occupational codes of technical and scientific organizations must be taken into account and be adjusted to legislation and the administration of justice.

More specific moral problems of the social scientists, especially internal and external responsibility in the social sciences are a result of the distinctive features of these fields. With the exception of psychology, there is a large deficit in the present state of discussion. In this respect certain problematic areas can only be identified and hypotheses suggested. To these belong experiments involving human subjects, the issue of research and scientific freedom and intervention in the rights of experimental subjects, the organization of ethics commissions, "informed consent", occupational or professional codes, protection of information (informational self-determination) and empirical investigation, political debate, economic experiments, the assessment of the consequences of technology from a social science perspective and the (co-)responsibility of the scientist, (the latter also considering the possibility of repercussions in reflexive prognoses), the (crypto-)normativity of the social sciences and the problem of their neutrality as regards value judgements (which is still of interest in the social sciences).

In regard to ethics in economics, an examination of the respective questions and problems (which cannot be repeated here in any detail) would render the following hypotheses. The ethical perspective in economics represents a meaningful supplement to an all too one-sided

economic point of view. Ethics, as individuality-oriented moral and as business ethics, has lately demanded a higher significance without, for its part, being able to give the field of economics overriding moral goals and solutions. (It is mainly concerned here with decisions and criteria of exemption.) The quality of business ethics or ethics in economics generally depends decisively on an adequate disciplinary analysis of economics mostly in regard to precise case studies. The central question of a normative system of ethics in economics is the question of the choice of actions that one should or should not perform, which is established through arguments or is justifiable, amongst a set of possible economic actions and according to the criteria for this selection. (Further essential questions concern so-called economic institutions and structures; for example, business, employment, markets –also in regard to individual social justice, fairness, etc., models of division of responsibility by collective action and the prevailing critical examination morals, norms, goals, etc. in business.) Business ethics –like ethics in general– is roughly divisible into descriptive, normative ethics and metaethics. –There is no independent *theoretical* discipline of "business ethics" that can be precisely identified through independent and individual fundamental principles and criteria. (The problems are mostly very similar to those of ethics in technology ("engineering ethics")). In any case, it is acceptable to relate ethics to specific, practice-oriented problems in the economy (as much to economic theory as to the real economy). In *practice*, a separate discipline of "economizing" or business ethics has been developed to a certain extent. It should be made mandatory to incorporate systematic and exemplary questions of economic ethics into all economic courses of study, just as examples of engineering ethics should be compulsory in engineering programs; in philosophy as well, an addition in regard to the questions of so-called applied ethics is meaningful and important. Business and engineering ethics are subvarieties of an ethics of the professions (Bowie) and are equal in respect to the problem structure, even if not necessarily in regard to the cases, involved subvalues, measures, means, and the emphasis. (A typical conflict refers to the tension between safety and economic profitability. Moreover, most engineers and economists –but not only these– work as dependent employees.)

1.3 *Problems of Distributing Responsibility*

Questions of distributing collective and corporate responsibility are distinguished and analyzed according to the following approaches:

1. relations and mutual dependance of agents and legal rules
2. models of moral responsibility distribution
3. responsibility and non-corporate actions
4. responsibility and corporate (institutional) actions
5. responsibility and (information) systems

1. In philosophical literature the problems of complex groups of interrelated agents causing the relevant actions and outcomes and questions of responsibility are usually dealt with unrelatedly but very globally, whereas in jurisprudence the problems are dealt with in more detail and some interesting approaches to solutions are attained (which apply to philosophy as well). By way of summarizing we might say that the actually convincing principle of attributing the responsibility to extant agent is running into some difficulties. These result from the divers and diverse forms of collective action and the non-individualizability of the causal integration within or with respect to synergistic and cumulative processes. Legal rules (*de lege lata*) typically fall short of considering ecological damages and damages that occur far from the sources of emissions and in regard to an adequate provision. The need for legal regulations is being widely recognized. Such topics as joint and total liability, including a mutual right to compensation, with recourse to the respective development of spheres of danger, (strict) product and danger liability that is independent of fault, the turnabout of the burden of proof, high probability of the extant causal agency, compensation out of capital funds, incentives to internalize externalities, etc., are being discussed and proposed in the literature. Prime difficulties of legal solutions certainly lie in the non-liability of permitted actions in subliminal individual contributions and in the definition and establishment of limiting and threshold values. (The relevance of legal considerations for philosophical discussion should be carefully tested.)

2. Cases in which somebody fully and exclusively has to take the responsibility are examined in philosophy as a rule. But are there not also other cases of co-operative responsibility, collective/co-operative decisions, and collective action in general, that are gaining much more importance today, in which someone carries full responsibility by sharing responsibility, according to the degree of the individual co-operation or accountability? In other words, does the extent of the distribution of responsibility generally reduce the degree of moral responsibility?

As a provisional result, the following should be emphasized in regard to this problem: the centre of the model of the distribution of res-

possibility is the question of the distribution of normative and descriptive responsibility (according to a theory of action) and the (equivalent) reduction of the collective responsibility to individual actors, which is dependent on the form of collective actions and causes; the respective form of collective action is also decisive and should, in the following, constitute a criterion for the distinction of various ways of attributing responsibility. A further point of emphasis is the distribution in terms of the responsibility type. If one makes a distinction between a duty to compensate and moral responsibility, then a division as a solution is more likely in the former case than in the latter. Particularly relevant to the distribution of responsibility are negative formulations of preventative and preservation responsibility as well as the responsibility to avoid omissions and failures, which seems to be more suited to be open to a regulation of the contributory and participatory form of responsibility distribution. One should also differentiate in regard to necessary and sufficient conditions of the onset of consequences and damages depending on the failed or omitted or unintentionally neglected actions of several actors.

3. Basic problems of responsibility distribution do not only arise out of the non-corporate collective action of many actors (be they corporations or individuals), but also out of specific strategic conditions, particularly in division-of-labour capitalist processes, that is, in labour segregation in the market external to corporations. The effects, results and side-effects of such actions have –and not just nowadays– an increasingly explosive nature. The difficulty is clarified with the help of examples of social traps, which until now were discussed mostly within the realm of individual rationality vs. collective irrationality (e.g., Prisoners' Dilemma).

Negative external synergistic and/or cumulative effects may occur when a large number of actors act along the lines of individual need calculations (only directly responsible for their own interests and acts). Particular components, that as such are relatively, i.e., subliminally, harmless, can lead as a whole to damages or even to the loss of highly appreciated "commons" or public property. It is characteristic of these damages that property rights (individual usage rights) are poorly or not at all defined or that they are not observed. Externalities are characterized by an incongruity between that for which one is actually responsible and that for which one is made responsible (liable). To avoid the external social costs, these results must, for example, be internalized (incorporated into the production functions of a business).

In regard to the problem of responsibility two subproblems emerge: firstly, the question of distribution of responsibility for or in view of cumulative and synergistic damages and, secondly, the question of responsibility for unforeseen or even unforeseeable consequences. With regard to the moral judgement, it follows from the subproblems that a personal causal responsibility cannot in general be attributed to an individual agent alone nor, under many a circumstance, can the cause be attributed to a single domain. Not only in the sense of the task and role responsibility, but also in the moral and legal sense do the concerned individuals take a co-responsibility corresponding to their active, potential or formal participation their constituting or influential shares (to be determined in each individual case). An extension of the responsibility of operationally manageable models of the distribution of (co-)responsibility are, considering the consequences of collective action, imperative. Appeals to the avoidance of social trap situations alone are not very useful. One must also introduce operationally available and efficient measures such as legal sanctions (product liability, collective responsibility, etc.), financial incentives to change production, determination of property rights for public goods, etc. The following could serve as a guideline: as many laws, regulations and prohibitions as necessary; as much incentive, individual initiative and individual responsibility as possible.

4. A second category of problems of responsibility distribution includes the external responsibility of corporations, i.e., the corporation and some or all of its members (representative responsibility vs. participatory responsibility), and corporation members alone (reducible to the specific types of responsibility); internal responsibility in differently structured corporations (hierarchies etc.) as individual responsibility and co-responsibility; the delegation of responsibility; and varying types of responsibility.

Moral responsibility –as the main and leading hypothesis– is, in regard to (at least ideal) corporate action, differentiable; corporations as such, corporation members, or the corporation and its members among others can be morally responsible. The attribution of individual moral responsibility must be separately justified in each case. In general, one should make a distinction between the external (moral, legal, role) responsibility of the corporations and the (corresponding) internal responsibility distribution.

In addition to the role or task specific, the legal and the action responsibility, corporations and institutions have a moral responsibility

or an accountability analogous to moral responsibility. This moral responsibility can also be understood as a secondary responsibility; it would exist in addition to and independent of the specific (individual responsibilities of the) individual corporation members. Individual responsibility and corporate responsibility do not have the same meaning; they cannot simply be mutually reduced to one another. The one responsibility does not replace the other.

Corporations can act "intentionally", though in a manner non-reducible to individual action (i.e., they act in the secondary sense, on a higher level of social fiction, on a symbolic or semantically structured and interpreted plane; their actions because of this and the social consequences are no less real than a person's actions). Such a corporate responsibility, that is not equivalent to the immediately bearable, direct, personal responsibility applies to businesses, the state and corporations as well as to technical and scientific organizations. Until now, the traditional a priori combination of the attribution of moral responsibility to natural persons, i.e., the concepts of responsibility linked to individuals, appeared to be unsurmountable barriers regarding the attribution of moral responsibility to corporations and situations. Must that be so? We think, no. Rather, the exclusive limitation to the individualistic model thwarted. Should one not rather develop a hierarchical model that adequately and differentially puts the responsibilities on the various levels?

Making corporations responsible can also constitute a first step of attributing responsibility in corporate action; the (corporation internal) distribution problem can be dealt with in a second step. The latter is difficult to deal with according to responsibility types. The following working hypotheses (which are also relevant to the ongoing project) have been formulated to address this point.

1. Only general distribution rules can be laid down with certainty.
2. These rules are (ideally) to be applied to each individual case with extra provisos regarding the special conditions.
3. The responsibility distribution is determined by the structures of the organization, decision-making structures and principles (individual and collective instances and units; unanimity or majority principles). (This applies to the social structure in general, too.)
4. The external responsibility in view of third parties, society and for their relevant instances, is dependent on the corporate structure, on the influence and control of individuals, on the contributions of (indi-

vidual) agents and in general on the internal responsibility distribution (in the sense of competency and task distribution and role-structure).

5. The internal responsibility for the fulfillment of tasks and roles with respect to colleagues is also primarily determined by the corporate structure. It is primarily an accountability to superiors and a special case of the role and task responsibility. (The observation of these duties is generally legally required, usually in form of a contract; it can also be morally required.)

6. Tasks and competencies and the accompanying responsibility can be delegated. The responsibility of the delegator does not (necessarily) end there. In general, however, moral responsibility, cannot be delegated.

7. The (normative) responsibility for the consequences of actions is primarily a result of the individual contributions of action and production. The individual director or order-giver, as well as the performer, acts. (The performance of an order or a command does not, however, generally exculpate the performer). The distribution of this (external or internal) responsibility, which assumes other responsibility distributions, results from the respective contribution to the production and from the involvedness of the actor or contributor.

8. Role and task responsibility results from formal as well as informal roles and tasks; the responsibility and its (external or internal) distribution depends on corporate structure, hierarchy and position.

9. Moral responsibility (in a narrower sense) as simply directly and personally attributable responsibility in view of external or internal addressees is made topical by its own action and possibilities of action. Moral responsibility is a function of power, influence and knowledge. The co-responsibility determines itself correspondingly with regard to the strategic placement of an individual in a corporation. It is increasing with growing formal authority of the bearer and the level or position within the hierarchy or corporate decision structure. The moral responsibility of A can be larger, smaller or equally large as that of B. However, responsibility distribution is not suited to percentage distribution analysis; it is better suited to comparative statements. Moral responsibility is not really divisible; it is open to sharing though. It can be borne solely (exclusively) or jointly (each person fully or partly). In the distribution model of moral responsibility the individuality of the attribution and the morally required non-disappearance of the co-responsibility it is necessary to take seriously the moral accountability even

in view of a growing number of participants (which might factually tend to minimize the personal share of the responsibility).

10. The legal distribution of responsibility is dealt with separately according to legal or natural persons, to the respective civil or criminal law, to legal aspects of administration or the state or constitutional approaches. In this way the legal person is, as a rule, liable to third parties for those who act on its behalf according to (German) civil law though not (in Germany for instance) according to the criminal law. Internally speaking, the corporation may have claims against natural persons (e.g. members). This is not the case with corporations which are not "legal persons" according to the German civil law.

5. A further problem of the responsibility distribution emerges from the use of expert and information systems. Can these be responsible? Besides the "responsibility ... in the systems" (Haefner); can we make complex informational decision-making systems and expert systems responsible? Is that not an unnoticed introduction of irresponsibility with no one to be appointed guilty, an injury of a taboo or even a categorial mistake of the analyzer?

It is sensible indeed to make computer systems more reliable, but it is not very meaningful to attribute moral trustworthiness and responsibility to them. Indeed, that would be absurd and sound odd! Computers are not moral beings, just as information systems are not social beings. In spite of their far-reaching social implications, human beings must carry the full responsibility for the use or misuse of technical systems –but which human beings? The programmer? The director of the computing centre? The entrepreneur? The politician? ... The responsibility may, in view of the possible far-reaching implications of responsible decisions for humans, especially individuals, hardly seem bearable, but morally it still exists. Human beings cannot morally deprive themselves of their power of decision and their accountability, cede their moral responsibility to computers and information systems. (This thesis must, however, still be established and worked out). In view of the factual expansion of automated conditioned decisions, this responsibility dilemma, which the participants and the higher decision-makers cannot avoid, will become more and more pressing in the future. Responsibility cannot be allowed to be diluted, either in anonymity or under the protection of committees, or in the information and decision-making systems. Possibilities of a counter-reaction exist in a higher sensitization of the responsibility awareness, in the development of a code of ethics for computer experts, in the interdisci-

plinary research and in an alliance in teaching and training of all knowledge-oriented disciplines, etc.

1.4 *Codes of Ethics and Responsibility Conflicts*

Approximately 280 Codes of Ethics or similar regulations like scientists' or engineers' oaths were recorded in our investigation; of these, two-thirds have been brought out as texts. The recorded codes come from various professional organizations (mostly American), especially from associations and societies of engineers and scientists. Initial comparisons and overviews indicated large correspondences in the Fundamental Principles and Canons; differences are found mostly in the specific Guidelines. The contents offer more of a sort of ethos of the respective profession than a genuine code of ethics (if "ethics" is understood in the strict sense relating to universal moral norms). A disadvantage in respect to the applicability at least for the respective professions in Germany is that the codes are too strongly oriented to engineers as self-employed or top managers; most (German) engineers do not fit these categories (but this seems to be true in the USA, too). A fundamental function of the Codes is the sensitization of engineers, scientists, engineering unions, and science and technical professionals and organizations to ethical problems and to conflicts between ethics and, for example, economic goals. The possibilities of implementing, applying and operationalizing the codes could also be more institutionalized.

In addition, the following hypothesis can be presented: Professional regulations and rules of behavior such as the codes of ethics should not just represent the current professional ethos; ethical considerations, general social values and goals have also to be recognized as somehow obligatory or effective guidelines; the orientation to the common good(s) should be strengthened, various institutional controls and possibilities of obtaining and furthering discipline should be included; particular notice should be given to the question of the structural interrelations to the market and in working (in businesses and corporations as well as institutions), to institutional corporate responsibility and to moral ideals. If the codes should still find stronger and increased entry into the positive law and gain a kind of legal status (maybe via clauses that need to be filled in like "good customs" (§138 BGB, German Civil Law)), so the chances of the realization of the codes would be enhanced, because appeals alone and the sensitization

of individuals –especially of dependant employees– do not seem to be sufficient, as necessary as they are indeed. Institutional supporting measures are also required. It remains important to include ethical and moral content in education and development and to provide for accompanying measures, i.e., discussion and publication of case studies, to establish ethics committees, to design and render committing professional oaths, etc., and to give legal support for ethical employees under pressure, so that the ethics codes do not prove to be just preferences or ineffective alibi appeals that have nothing to do with real life. (The books - "Technik und Ethik" ("Technology and Ethics") (eds. H. Lenk, G. Ropohl, Stuttgart 1987, 2nd edition 1989), "Wissenschaft und Ethik" ("Science and Ethics") (ed. H. Lenk, Stuttgart 1991) and "Wirtschaft und Ethik" ("Economics and Ethics") (eds. H. Lenk, M. Maring, Stuttgart 1992) - offer material on this topic.)

There is a sort of social traps involved in abiding by or profiting from ethical codes: People who follow the rules must often deal with disadvantages, while those who transgress them can benefit from advantages (especially when the infringement can be hidden). Problems of control, sanction, trust and security also arise; these cannot be solved through codes alone. Additional institutional measures are necessary.

In regard to responsibility conflicts in practice, the hypothesis to adopt is that no isolated solutions or suggestions are possible for such cases; instead, applicability rules or practical guidelines on a intermediate level should be developed. These rules should differentiate, for example, between moral ideals and moral (obligatory) rules (Gert/Hennessey). A combination of individual and institutional measures is necessary: To further and strengthen individual ethical competence is a necessary, but by no means a sufficient step for the efficient solution of responsibility problems and conflicts. An implementation of ethical considerations in law and politics would supplement and enhance this. In particular, the codes must set priorities and decision criteria, which would aid in the solution of conflicts.

Codes of ethics were gathered for the aforementioned collections, "Science and Ethics" and "Economics and Ethics", as well as for "Technology and Ethics". Business guidelines, principles of management, company codes, etc., differ considerably from the engineering and science codes. The latter relate to specific jobs and correspond to specific tasks, duties and responsibilities –also to varying requirements of the respective associations. The company codes primarily determine

goals and tasks for the business and its employees in external as well as internal affairs. The Davos Manifesto –a code of conduct for management– more closely resembles an engineering or science code. Oaths for business managers and economists that were suggested at a commencement day celebration at St. Gallen University (Switzerland) are, on the other hand, modelled on the Hippocratic oath for physicians. (Differences in regard to the various codes could be examined more closely; this goes as well for other approaches in engineering and business ethics.)

As mentioned, most engineers and scientists work as dependent employees in industry. Insofar for them the respective company codes, principles of management, as well as guidelines for specific jobs, etc., are relevant which are usually discussed in business ethics. In practical job situations the technology-related and science-oriented questions and problems are combined, so that a clean separation of these is neither beneficial nor meaningful in this realm. Responsibility for technology and science (research) is particularly concretized in corporate acting in and for businesses.

1.5 *Priority Rules*

Enclosing, we would like to mention the following ten rules of preference and priority which are arranged in a successive order and valid under *prima-facie*-conditions (that is they may be over-ruled by higher and more binding moral obligations). (The first four rules are adapted from Patricia H. Werhane: *Persons, Rights, and Corporations*. Englewood Cliffs, N J 1985, pp. 72.)

1. To weigh moral rights of the respective individual; these moral rights are predistributive rights overriding utility considerations.

2. To seek a compromise taking into consideration interests of everyone on an equal basis; in case of an unsolvable or seemingly unsolvable conflict between equally relevant basic rights the condition mentioned in the clause is especially important.

3. Only after considering the moral rights of each party one should vote for the solution which causes the least damage or maximizes utility for all involved parties.

4. Only after application of rule 1., 2. and 3. utility considerations are to be weighed against potential harm. That means in general: Nonalienable (predistributive) moral rights are prior to considerations

of avoiding harm and damage and these latter are prior to utility considerations.

5. In practically unsolvable conflicts one should look for fair compromises (that is for compromises which involve proximately equally distributed or proportionally justified distributions of disadvantages and utilities respectively.)

6. General (higher level) moral responsibility is to obtain a preference over restricted nonmoral prima-facie-obligations.

7. Universal moral responsibility generally takes preference over role and task responsibility.

8. Direct primary moral responsibility is usually but not always to be considered prior to indirect responsibility for remote consequences. (This is true because of urgency but must necessarily be modified according to importance and impact of consequences and long range effectiveness.)

9. Primary and personal moral responsibility precedes secondary corporative responsibility.

10. The public weal, the common good precedes all other specific and particular interests.

In technical rules and regulations for applied science important principles of priority are formulated regarding safety regulations, e.g. the rule DIN 31000 of the German Technical Regulation DIN explicitly states: "With respect to safe design that solution has to be preferred for which the safety goals will be reached in a technologically meaningful way and the best economical manner. In case of doubt safety requirements take precedence over economical consideration."

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